

# $\Lambda$ BARYONS

## ( $S = -1, I = 0$ )

$$\Lambda^0 = uds$$

$\Lambda$

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass  $m = 1115.683 \pm 0.006$  MeV

$$(m_\Lambda - m_{\bar{\Lambda}}) / m_\Lambda = (-0.1 \pm 1.1) \times 10^{-5} \quad (S = 1.6)$$

Mean life  $\tau = (2.632 \pm 0.020) \times 10^{-10}$  s  $(S = 1.6)$

$$(\tau_\Lambda - \tau_{\bar{\Lambda}}) / \tau_\Lambda = -0.001 \pm 0.009$$

$$c\tau = 7.89 \text{ cm}$$

Magnetic moment  $\mu = -0.613 \pm 0.004 \mu_N$

Electric dipole moment  $d < 1.5 \times 10^{-16}$  e cm, CL = 95%

### Decay parameters

$$p\pi^- \quad \alpha_- = 0.642 \pm 0.013$$

$$\bar{p}\pi^+ \quad \alpha_+ = -0.71 \pm 0.08$$

$$p\pi^- \quad \phi_- = (-6.5 \pm 3.5)^\circ$$

$$" \quad \gamma_- = 0.76 \text{ [a]}$$

$$" \quad \Delta_- = (8 \pm 4)^\circ \text{ [a]}$$

$$n\pi^0 \quad \alpha_0 = 0.65 \pm 0.04$$

$$pe^- \bar{\nu}_e \quad g_A/g_V = -0.718 \pm 0.015 \text{ [b]}$$

$\Lambda$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$p\pi^-$	$(63.9 \pm 0.5) \%$	101
$n\pi^0$	$(35.8 \pm 0.5) \%$	104
$n\gamma$	$(1.75 \pm 0.15) \times 10^{-3}$	162
$p\pi^- \gamma$	$[c] (8.4 \pm 1.4) \times 10^{-4}$	101
$pe^- \bar{\nu}_e$	$(8.32 \pm 0.14) \times 10^{-4}$	163
$p\mu^- \bar{\nu}_\mu$	$(1.57 \pm 0.35) \times 10^{-4}$	131

$\Lambda(1405) 1/2^-$

$$I(J^P) = 0(\frac{1}{2}^-)$$

Mass  $m = 1405.1^{+1.3}_{-1.0}$  MeV

Full width  $\Gamma = 50 \pm 2$  MeV

Below  $\bar{K}N$  threshold

$\Lambda(1405)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$\Sigma \pi$	100 %	155

$\Lambda(1520) 3/2^-$

$$I(J^P) = 0(\frac{3}{2}^-)$$

Mass  $m = 1519.5 \pm 1.0$  MeV [d]

Full width  $\Gamma = 15.6 \pm 1.0$  MeV [d]

$$p_{\text{beam}} = 0.39 \text{ GeV}/c \quad 4\pi\lambda^2 = 82.8 \text{ mb}$$

NODE=BXXX020

NODE=S018

NODE=S018M;DTYPE=M

NODE=S018DM;DTYPE=x

NODE=S018T;DTYPE=T

NODE=S018DT;DTYPE=t

NODE=S018CTA;DTYPE=C;OUR EVAL

NODE=S018MM;DTYPE=m

NODE=S018EDM;DTYPE=e

CLUMP=D

NODE=S018A-;DTYPE=d;CLUMP=D

NODE=S018A+;DTYPE=d;CLUMP=D

NODE=S018F-;DTYPE=d;CLUMP=D

NODE=S018G-;DTYPE=d;CLUMP=D;OUR

EVAL; → UNCHECKED ←

NODE=S018D-;DTYPE=d;CLUMP=D;OUR

EVAL; → UNCHECKED ←

NODE=S018A0+;DTYPE=d;CLUMP=D;

OUR EVAL

NODE=S018AV;DTYPE=d;CLUMP=D

NODE=S018235;DESIG=1

DESIG=2

DESIG=6

DESIG=5

DESIG=4

DESIG=3

NODE=B037

NODE=B037M1;DTYPE=M

NODE=B037W1;DTYPE=G

NODE=B037215;DESIG=1;OUR EST

NODE=B038

NODE=B038M;DTYPE=M;OUR EST;

→ UNCHECKED ←

NODE=B038W;DTYPE=G;OUR EST;

→ UNCHECKED ←

NODE=B038B;DTYPE=P;OUR EVAL

$\Lambda(1520)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	$45 \pm 1\%$	243
$\Sigma\pi$	$42 \pm 1\%$	268
$\Lambda\pi\pi$	$10 \pm 1\%$	259
$\Sigma\pi\pi$	$0.9 \pm 0.1\%$	169
$\Lambda\gamma$	$0.85 \pm 0.15\%$	350

NODE=B038215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=3;OUR EST  
DESIG=6;OUR EST  
DESIG=4;OUR EST

 **$\Lambda(1600) 1/2^+$** 

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass  $m = 1560$  to  $1700$  ( $\approx 1600$ ) MeV  
Full width  $\Gamma = 50$  to  $250$  ( $\approx 150$ ) MeV  
 $p_{\text{beam}} = 0.58$  GeV/c  $4\pi\lambda^2 = 41.6$  mb

NODE=B101

NODE=B101M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B101W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B101BB;DTYPE=P;OUR EVAL

$\Lambda(1600)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	15–30 %	343
$\Sigma\pi$	10–60 %	338

NODE=B101215;DESIG=1;OUR EST  
DESIG=2;OUR EST

 **$\Lambda(1670) 1/2^-$** 

$$I(J^P) = 0(\frac{1}{2}^-)$$

Mass  $m = 1660$  to  $1680$  ( $\approx 1670$ ) MeV  
Full width  $\Gamma = 25$  to  $50$  ( $\approx 35$ ) MeV  
 $p_{\text{beam}} = 0.74$  GeV/c  $4\pi\lambda^2 = 28.5$  mb

NODE=B040

NODE=B040M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B040W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B040BB;DTYPE=P;OUR EVAL

$\Lambda(1670)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–30 %	414
$\Sigma\pi$	25–55 %	394
$\Lambda\eta$	10–25 %	69

NODE=B040215;DESIG=1;OUR EST  
DESIG=3;OUR EST  
DESIG=2;OUR EST

 **$\Lambda(1690) 3/2^-$** 

$$I(J^P) = 0(\frac{3}{2}^-)$$

Mass  $m = 1685$  to  $1695$  ( $\approx 1690$ ) MeV  
Full width  $\Gamma = 50$  to  $70$  ( $\approx 60$ ) MeV  
 $p_{\text{beam}} = 0.78$  GeV/c  $4\pi\lambda^2 = 26.1$  mb

NODE=B055

NODE=B055M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B055W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B055BB;DTYPE=P;OUR EVAL

$\Lambda(1690)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–30 %	433
$\Sigma\pi$	20–40 %	410
$\Lambda\pi\pi$	$\sim 25\%$	419
$\Sigma\pi\pi$	$\sim 20\%$	358

NODE=B055215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=3;OUR EST  
DESIG=4;OUR EST

 **$\Lambda(1800) 1/2^-$** 

$$I(J^P) = 0(\frac{1}{2}^-)$$

Mass  $m = 1720$  to  $1850$  ( $\approx 1800$ ) MeV  
Full width  $\Gamma = 200$  to  $400$  ( $\approx 300$ ) MeV  
 $p_{\text{beam}} = 1.01$  GeV/c  $4\pi\lambda^2 = 17.5$  mb

NODE=B036

NODE=B036M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B036W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B036BB;DTYPE=P;OUR EVAL

$\Lambda(1800)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	25–40 %	528
$\Sigma\pi$	seen	494
$\Sigma(1385)\pi$	seen	349
$N\bar{K}^*(892)$	seen	†

NODE=B036215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=3;OUR EST  
DESIG=181;OUR EST

 **$\Lambda(1810) 1/2^+$** 

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass  $m = 1750$  to  $1850$  ( $\approx 1810$ ) MeV  
Full width  $\Gamma = 50$  to  $250$  ( $\approx 150$ ) MeV  
 $p_{\text{beam}} = 1.04$  GeV/c  $4\pi\lambda^2 = 17.0$  mb

NODE=B077

NODE=B077M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B077W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B077BB;DTYPE=P;OUR EVAL

$\Lambda(1810)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–50 %	537
$\Sigma\pi$	10–40 %	501
$\Sigma(1385)\pi$	seen	357
$N\bar{K}^*(892)$	30–60 %	†

NODE=B077215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=3;OUR EST  
DESIG=181;OUR EST

 **$\Lambda(1820) 5/2^+$** 

$$I(J^P) = 0(\frac{5}{2}^+)$$

Mass  $m = 1815$  to  $1825$  ( $\approx 1820$ ) MeV  
Full width  $\Gamma = 70$  to  $90$  ( $\approx 80$ ) MeV  
 $p_{\text{beam}} = 1.06$  GeV/c  $4\pi\lambda^2 = 16.5$  mb

NODE=B039

NODE=B039M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B039W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B039BB;DTYPE=P;OUR EVAL

$\Lambda(1820)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	55–65 %	545
$\Sigma\pi$	8–14 %	509
$\Sigma(1385)\pi$	5–10 %	366

NODE=B039215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=7;OUR EST

 **$\Lambda(1830) 5/2^-$** 

$$I(J^P) = 0(\frac{5}{2}^-)$$

Mass  $m = 1810$  to  $1830$  ( $\approx 1830$ ) MeV  
Full width  $\Gamma = 60$  to  $110$  ( $\approx 95$ ) MeV  
 $p_{\text{beam}} = 1.08$  GeV/c  $4\pi\lambda^2 = 16.0$  mb

NODE=B056

NODE=B056M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B056W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B056BB;DTYPE=P;OUR EVAL

$\Lambda(1830)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	3–10 %	553
$\Sigma\pi$	35–75 %	516
$\Sigma(1385)\pi$	>15 %	374

NODE=B056215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=3;OUR EST

 **$\Lambda(1890) 3/2^+$** 

$$I(J^P) = 0(\frac{3}{2}^+)$$

Mass  $m = 1850$  to  $1910$  ( $\approx 1890$ ) MeV  
Full width  $\Gamma = 60$  to  $200$  ( $\approx 100$ ) MeV  
 $p_{\text{beam}} = 1.21$  GeV/c  $4\pi\lambda^2 = 13.6$  mb

NODE=B060

NODE=B060M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B060W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B060BB;DTYPE=P;OUR EVAL

$\Lambda(1890)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	20–35 %	599
$\Sigma\pi$	3–10 %	560
$\Sigma(1385)\pi$	seen	423
$N\bar{K}^*(892)$	seen	236

NODE=B060215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=181;OUR EST  
DESIG=6;OUR EST

**$\Lambda(2100) 7/2^-$**

$$I(J^P) = 0(\frac{7}{2}^-)$$

Mass  $m = 2090$  to  $2110$  ( $\approx 2100$ ) MeV

Full width  $\Gamma = 100$  to  $250$  ( $\approx 200$ ) MeV

$$p_{\text{beam}} = 1.68 \text{ GeV}/c \quad 4\pi\lambda^2 = 8.68 \text{ mb}$$

NODE=B041

NODE=B041M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B041W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B041BB;DTYPE=P;OUR EVAL

$\Lambda(2100)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	25–35 %	751
$\Sigma\pi$	$\sim 5$ %	705
$\Lambda\eta$	$<3$ %	617
$\Xi K$	$<3$ %	491
$\Lambda\omega$	$<8$ %	443
$N\bar{K}^*(892)$	10–20 %	515

NODE=B041215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=5;OUR EST  
DESIG=3;OUR EST  
DESIG=4;OUR EST  
DESIG=181;OUR EST

**$\Lambda(2110) 5/2^+$**

$$I(J^P) = 0(\frac{5}{2}^+)$$

Mass  $m = 2090$  to  $2140$  ( $\approx 2110$ ) MeV

Full width  $\Gamma = 150$  to  $250$  ( $\approx 200$ ) MeV

$$p_{\text{beam}} = 1.70 \text{ GeV}/c \quad 4\pi\lambda^2 = 8.53 \text{ mb}$$

NODE=B035

NODE=B035M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B035W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B035BB;DTYPE=P;OUR EVAL

$\Lambda(2110)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	5–25 %	757
$\Sigma\pi$	10–40 %	711
$\Lambda\omega$	seen	455
$\Sigma(1385)\pi$	seen	591
$N\bar{K}^*(892)$	10–60 %	525

NODE=B035215;DESIG=1;OUR EST  
DESIG=2;OUR EST  
DESIG=3;OUR EST  
DESIG=4;OUR EST  
DESIG=5;OUR EST

**$\Lambda(2350) 9/2^+$**

$$I(J^P) = 0(\frac{9}{2}^+)$$

Mass  $m = 2340$  to  $2370$  ( $\approx 2350$ ) MeV

Full width  $\Gamma = 100$  to  $250$  ( $\approx 150$ ) MeV

$$p_{\text{beam}} = 2.29 \text{ GeV}/c \quad 4\pi\lambda^2 = 5.85 \text{ mb}$$

NODE=B042

NODE=B042M;DTYPE=M;OUR EST;  
→ UNCHECKED ←  
NODE=B042W;DTYPE=G;OUR EST;  
→ UNCHECKED ←  
NODE=B042BB;DTYPE=P;OUR EVAL

$\Lambda(2350)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	$p$ (MeV/c)
$N\bar{K}$	$\sim 12$ %	915
$\Sigma\pi$	$\sim 10$ %	867

NODE=B042215;DESIG=1;OUR EST  
DESIG=2;OUR EST

## NOTES

[a] The decay parameters  $\gamma$  and  $\Delta$  are calculated from  $\alpha$  and  $\phi$  using

$$\gamma = \sqrt{1-\alpha^2} \cos\phi, \quad \tan\Delta = -\frac{1}{\alpha} \sqrt{1-\alpha^2} \sin\phi.$$

LINKAGE=SBE

See the "Note on Baryon Decay Parameters" in the neutron Particle Listings.

[b] The parameters  $g_A$ ,  $g_V$ , and  $g_{WM}$  for semileptonic modes are defined by  $\bar{B}_f[\gamma\lambda(g_V + g_A\gamma_5) + i(g_{WM}/m_{B_i})\sigma_{\lambda\nu}q^\nu]B_i$ , and  $\phi_{AV}$  is defined by  $g_A/g_V = |g_A/g_V|e^{i\phi_{AV}}$ . See the "Note on Baryon Decay Parameters" in the neutron Particle Listings.

LINKAGE=SBD

[c] See the Listings for the pion momentum range used in this measurement.

LINKAGE=SD

[d] The error given here is only an educated guess. It is larger than the error on the weighted average of the published values.

LINKAGE=BH